

## New LCA Theses

### Environmental Valuation and Life Cycle Assessment

#### Thesis for the Degree of Licentiate of Engineering

Magnus Bengtsson

Environmental Systems Analysis, Chalmers University of Technology, SE-41296 Göteborg, Sweden; e-mail: [Magnus.Bengtsson@esa.chalmers.se](mailto:Magnus.Bengtsson@esa.chalmers.se)

Today, many companies try to investigate the environmental impacts of their products in a "cradle-to-grave" perspective. In these life cycle assessment (LCA) studies, ways are needed to decide which impacts are regarded as the most severe, and in some cases there is also a need for expressing overall environmental impact in a one-dimensional format. Researchers and consultants have developed a number of different weighting methods to this end.

The thesis aims at an investigation of two different kinds of social contexts. The first kind of context is the practice of LCA: the decision-making and learning processes in which life cycle studies are carried out and where weighting methods are used. The aim of investigations of these processes is to better understand how weighting methods are used and perceived and how, or if, they can contribute to making life cycle data meaningful to those concerned. The second context type is related to methods development; it comprises different attempts to measure values, attitudes and opinions concerning environmental changes for the purpose of expressing the relative severity of such changes. The thesis is based on both case-studies, interviews with LCA practitioners and their clients, and theoretical reflection.

The purpose of LCA is not to calculate a true or correct answer in a universal sense; it can better be described as the gradual construction of an argument. In constructing this argument, lots of value-laden choices and approximations are made, and for credible, trustworthy results these must be made in ways that seem reasonable, or at least acceptable, to the intended audience(s). For this reason, it is necessary to have a clear picture of to whom the results of a study are directed. It is the world-views of the receivers of a particular study that is the ultimate basis for good methodological choices – not the opinion of a group of researchers. A need for many different weighting methods was observed in order to match not only the world-views and ethical orientations of the responsible decision-maker(s), but also of the intended audiences, i.e. internal and external actors to whom the results of a study are directed.

It is also concluded that it is important that the analyst in life cycle studies makes clear to the problem-owners that they need to be involved in the study. It was noticed that the view of LCA as being a highly standardised calculation tool could be a hindrance for such involvement. It is argued that life cycle studies are, to a large extent, of an interpretative,

case-specific nature and not so much about strictly following previously specified, general rules.

Another observation is that aggregated measures of environmental impact are difficult to understand and to use in product development and decision-making. This is partly due to the fact that such measures are expressed in units that are not familiar to, and hence not meaningful to, those concerned. Because of this, weighted results are only useful for 'less is better' conclusions; comparisons with other product characteristics, e.g. production cost and technical performance, are not feasible in cases where there is a conflict between any of these other characteristics and environmental impacts.

It was also noted that weighted, quantitative results may have a large rhetorical power, and that it is difficult to communicate the uncertainty of such measures. Since the uncertainty is not only of a technical character, but also a result of value-laden methodological choices, mathematical expressions of uncertainty are of limited use for these purposes.

The thesis also discusses some underlying difficulties of measuring values and attitudes for the development of general weighting methods. This deals with the second context introduced above. It was found that LCA methodology is built on a number of assumptions that make such investigations problematic. An example is the idea that environmental damages caused by an activity may be meaningfully assessed without involving the utility provided by the activity. It is argued that people are likely to assess a certain environmental change differently, depending on what was the cause of that change. Another fundamental assumption, which we cannot assume to be universally approved, is the idea that increased environmental burden at one stage in a life cycle can be compensated for by reductions at other stages. It is not self-evident that such compensation is regarded as possible and just. There are alternative, fully rational ways of thinking about environmental values and impacts that do not fit into the LCA framework. Since these are excluded almost by default, we cannot assume LCA results to be generally accepted.

A further development of LCA methodology and practice requires deepened insights in both these fields: how results from real-life LCA studies are interpreted and used, and how people's values and concerns for the environment may be investigated and included in such studies in ways that are perceived as meaningful and legitimate.